计算物理

课程教学大纲

<table>
<tr><td colspan="6">课程基本信息（Course Information）</td></tr>
<tr><td>课程代码
（Course Code）</td><td>PH336</td><td>学时
（Credit Hours）</td><td>48</td><td>学分
（Credits）</td><td>3</td></tr>
<tr><td rowspan="2">课程名称
（ Course Name）</td><td colspan="5">计算物理</td></tr>
<tr><td colspan="5">Computational Physics</td></tr>
<tr><td>课程性质
(Course Type)</td><td colspan="5">专业课</td></tr>
<tr><td>授课语言
(Language of Instruction)</td><td colspan="5">英语/English</td></tr>
<tr><td>开课院系
（School）</td><td colspan="5">物理与天文系/Department of Physics and Astronomy</td></tr>
<tr><td>先修课程
（Prerequisite）</td><td colspan="5">大学物理/University Physics</td></tr>
<tr><td>授课教师
（Teacher）</td><td colspan="2">顾卫华/Gu, Weihua</td><td>电邮、电话
（email& phone）</td><td colspan="2">whgu@sjtu.edu.cn</td></tr>
<tr><td>办公时间
（Office Time）</td><td colspan="2"></td><td>办公地点
（Office Location）</td><td colspan="2"></td></tr>
<tr><td>课程网址
(Course Webpage)</td><td colspan="5"></td></tr>
<tr><td>*课程简介
（Description）</td><td colspan="5">计算物理是一门物理专业的英语课程，课程的对象是物理系本科三年级的学生。本课程的特点是跨学科性，涉及的内容既包括物理学中的经典力学，热学，电磁学，分形学，混沌理论等，也包括计算科学中的编程，数值计算和数据处理等。计算物理提倡以学生为中心的教学理念，教学目标是希望通过本课程的学习， 学生们可以应用数值计算方法解决实际的物理问题， 探索新的物理现象， 增强解决问题的能力， 并且利用英语教和学的过程， 提升学生英语阅读和表达的能力。</td></tr>
<tr><td>*课程简介
（Description）</td><td colspan="5">As an English course offered by the Department of Physics and Astronomy, Computational Physics is primarily intended for third-year undergraduate students in physics. The course is characterized by its interdisciplinary nature, with its topics ranging from the classical mechanics, thermodynamics, electromagnetism, fractal theory, chaos theory in the discipline of physics, to programming, numerical computation, data analysis and etc. in the discipline of computer science. The course tries to follow the guidelines of student-centered teaching. After learning the course the students shall be able to apply and evaluate various numerical methods to solve practical</td></tr>
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	physical problems, they shall thus be able to explore new physical phenomenon and enhance their problem-solving skills. The course is also helpful for the students to enhance their English skills.
课程教学大纲（course syllabus） 1. 计算物理引论 2. 误差分析基础， 3. 蒙特卡洛模拟(非热力学)， 4. 数值积分 5. 数值微商 6. 求解方程根， 7. 矩阵运算， 8. 数据拟合， 9. 常微分方程的数值求解 10. 离散和连续的非线性系统 11. 分形和簇生长 12. 偏微分方程数值求解基础 1. Computational science basics 2. Error & Uncertainties in computations 3. Monto Carlo Simulations (Nonthermal) 4. Integration 5. Differentiation 6. Searching for roots 7. Solving systems of equations with matrices 8. Interpolation & data fitting 9. Ordinary differential equations 10. Discrete & continuous nonlinear dynamics 11. Fractals & statistical growth 12. Partial differential equations	
*学习目标 (Learning Outcomes)	(须根据课程性质，着重描述课程教学在培养学生知识、能力、素质等方面的贡献，是课程目标的细化，专业培养计划内课程必须与专业培养目标具体贡献点相对应；其他类型课程请根据课程实际情况从三方面描述。 1．学习知识点：数值计算方法 2．学习并提高 matlab/Java 等编程能力 3．提高分析思考能力 4．提高解决问题能力 5．提高英语能力 6．提高表述能力，包括完成书面报告，包括描述问题本身，描述解决问题的方法，呈现数值计算结果的图表，和分析结果，以及积极参加和同学老师的讨论。 7．通过共同完成小组作业提高小组合作工作能力。 After learning the course, the students shall be able to 1. understand various numerical methods, 2. writematlab/java programs,

	3. enhance their analytical thinking skills, 4. enhance their problem-solving skills, 5. enhance their English skills, 6. enhance their presentation skills by writing homework reports (describe, analyze the problems and the numerical solutions, draw diagrams/tables to present the results and evaluate them), and by participating actively in the discussions with the instructors and peers. 7. Enhance their team-working skills by working together on their group assignments.

*教学内容、进度安排及要求 (Class Schedule &Requirements)

教学内容	学时	教学方式	作业及要求	基本要求	考查方式
1. Computational science basics	3	授课	每周作业	上课，完成作业	
2. Error & Uncertainties in computations	3	授课，课堂讨论	√	上课，完成作业	小测
3. Monto Carlo Simulations (Nonthermal)	4	授课	√	上课，完成作业	
4. Integration	4	授课，课堂讨论	√	上课，完成作业	小测
5. Differentiation	3	授课	√	上课，完成作业	
6. Searching for roots	4	授课	√	上课，完成作业	小测
7. Solving systems of equations with matrices	4	授课，课堂讨论	√	上课，完成作业	
8. Interpolation & data fitting	4	授课	√	上课，完成作业	小测，期中考试
9. Ordinary differential equations	8	授课，课堂讨论	√	上课，完成作业	
10. Discrete & continuous nonlinear dynamics	4	授课	√	上课，完成作业	小测
11. Fractals & statistical growth	3	授课	√	上课，完成作业	
12. Partial	4	授课，	√	上课，完	期末考

	differential equations		课堂讨论		成作业	试

Teaching Materials	Lectures	Teaching Methods	Homework	Requirements	Assessment
1. Computational science basics	3	Lecturing	Weekly, √	Be present, submit homework	
2. Error & Uncertainties in computations	3	Lecturing, class discussion	√	Be present, submit homework	Quiz
3. Monto Carlo Simulations (Nonthermal)	4	Lecturing	√	Be present, submit homework	
4. Integration	4	Lecturing, class discussion	√	Be present, submit homework	Quiz
5. Differentiation	3	Lecturing	√	Be present, submit homework	
6. Searching for roots	4	Lecturing	√	Be present, submit homework	Quiz
7. Solving systems of equations with matrices	4	Lecturing, class discussion	√	Be present, submit homework	
8. Interpolation & data fitting	4	Lecturing	√	Be present, submit homework	Quiz, mid-term exam
9. Ordinary differential equations	8	Lecturing, class discussion	√	Be present, submit homework	
10. Discrete & continuous nonlinear dynamics	4	Lecturing	√	Be present, submit homework	Quiz
11. Fractals & statistical growth	3	Lecturing	√	Be present, submit homework	
12. Partial differential	4	Lecturing, class	√	Be present, submit	Final-term exam

	equations		discussion		homework	
*考核方式 (Grading)	20%平时作业， 10%项目作业， 10%小测， 30%期中考试， 30%期末考试 20%assignments, 10%proect， 10%quizes， 30%mid-term exam， 30%final-term exam					
*教材或参考资料 (Textbooks & Other Materials)	1. Nicholas J. Giordano, 计算物理，第2版，清华大学额出版社。 2. Haiyan Zhang, An Introduction to Computational physics, 上海交通大学出版社。 3. J.N. Kutz, Scientific Computing, www.coursera.org 4. John H. Mathews, 数值方法(MATLAB.), 第4版， 电子工业出版社。 5. Rubin H. Landau et al, A Survey of Computational Physics, Princeton University Press.					
其它 （More）						
备注 （Notes）						

备注说明：

1.多于1位教师授课的课程，如公共课程、基础课程等经教学团队商议后由负责人填写。

2.带*为必填项目，其他栏目根据课程情况选填。

3.课程简介字数为300-500字；课程大纲以表述清楚教学安排为宜，字数不限。